Space Weather Technical Forecast

Issued on Tuesday 28 January 2025 at 12:12 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. Chance of G1 minor geomagnetic storms on day 4 (31 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been at Low levels, with no significant flares observed through the period.

There are currently seven sunspot regions on the Earth-facing disc. AR3967 in the southwest has continued to see intermediate spots fading away. AR3974 in the southeast has increased in size, with further trailing spots now becoming visible. Two more new regions emerging over the northeastern limb, AR3976 and AR3977, have been reanalysed as they become more visible. These regions are possibly ex-AR3947 and ex-AR3953, which were both active regions on the previous rotation. The more southerly of these two regions may have been responsible for the M2.6 flare at 27/0812 UTC.

No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was at background levels, generally around 300 km/s. Density was above average initially up to 25ppcc, before returning to average levels. The Interplanetary Magnetic Field, Bt, was weak to moderate, peaking near 10nT. The north-south component, Bz, mostly varied weakly between +/-7nT. The phi angle fluctuated but was mostly negative (towards the Sun). Geomagnetic activity was mostly Quiet (Kp0-2) with one Unsettled (Kp3) interval 27/1500-1800UTC.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 reached High levels, with a diurnal peak of 2530pfu observed at 27/1525 UTC before dropping to normal background levels. The associated 24-hour fluence persisted below the Active threshold, reaching 3.41e7 integrated pfu at 28/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected with a chance of further isolated M-class flares, and a slight chance of X-class flares. The flare probabilities do increase slowly through the

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period as AR3976 and AR3977 rotate further across the disk. AR3977 is possibly Ex-3947 which produced several X-class flares on its previous rotation.

Solar Wind / Geomagnetic Activity: A CME associated with a filament eruption around midnight on 26 Jan may give a weak glancing blow late on Day 1 (28 Jan) or early on Day 2 (29 Jan), albeit this is low confidence with most of the CME expected to miss Earth. A large coronal hole, currently in the eastern hemisphere, may become geoeffective into Day 4 (31 Jan).

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 1 (28 Jan) or early Day 2 (29 Jan) should any glancing CME arrive. A rising risk of Active, or possibly G1 minor storm, intervals then on Day 4 (31 Jan) with any connection to coronal hole high speed stream.

Energetic Particles / Solar Radiation: There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold, should any larger flares occur from the western hemisphere.

GOES16 high energy electron flux is likely to show a gradual decline. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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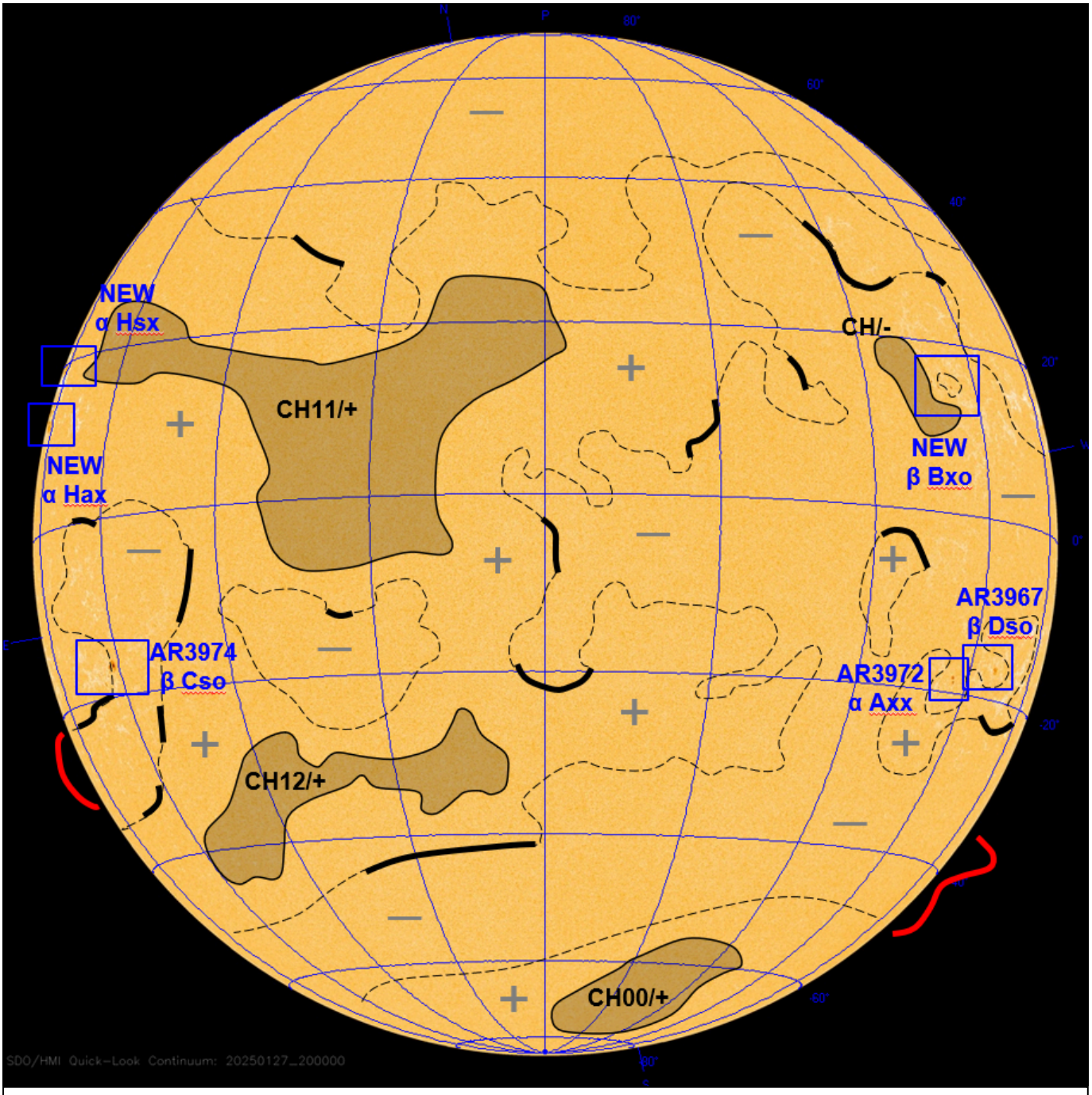
Figure 1: Solar Synoptic Map valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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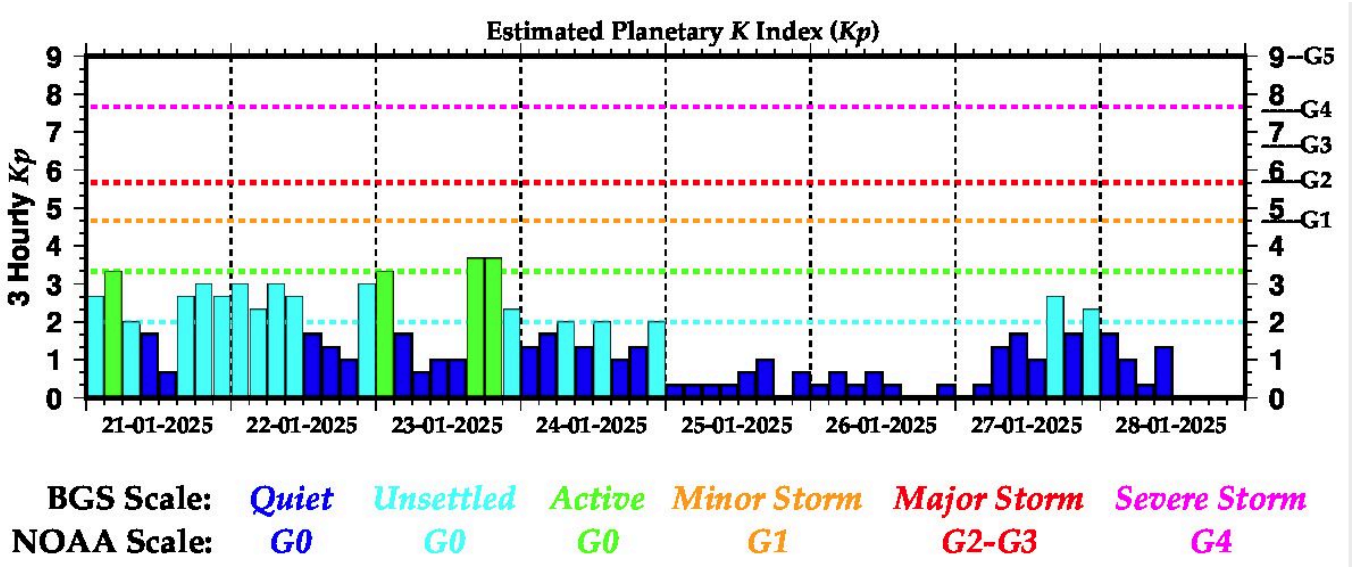
Geomagnetic Storms

No new CMEs feature in the forecast. A CME associated with a filament eruption around midnight on the 26 Jan may give a weak glancing blow late on Day 1 (28 Jan) or early on Day 2 (29 Jan), this is low confidence however with most of the CME expected to miss Earth. A large recurrent coronal hole (CH11/+), currently in the eastern hemisphere, may connect with Earth later on Day 4 (31 Jan), with winds on the previous rotation reaching Elevated levels. MOSWOC Enlil is probably too quick to connect this feature with Earth.

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 1 (28 Jan) or early Day 2 (29 Jan) should any glancing CMEs arrive. An increasing risk of Active, or possibly G1 minor storm, intervals then possible on Day 4 (31 Jan) with any connection to CH11/+ high speed stream.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	30
Strong	G3	No	1	1	1	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Estimated planetary K index from BGS



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Radio Blackouts - X-Ray Flares

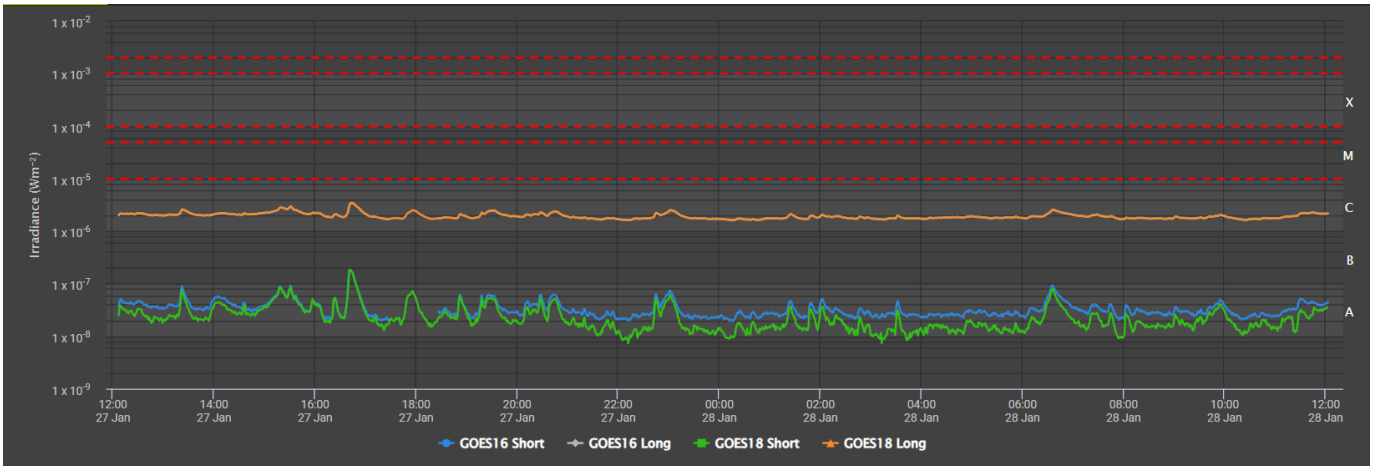
There are currently seven sunspot regions on the Earth-facing disc. AR3967 in the southwest has continued to see intermediate spots fading away. AR3974 in the southeast has increased in size, with further trailing spots now becoming visible. Two more new regions emerging over the northeastern limb, AR3976 and AR3977, have been reanalysed as they become more visible. These regions are possibly ex-AR3947 and ex-AR3953, which were both active regions on the previous rotation. The more southerly of these two regions may have been responsible for the M2.6 flare at 27/0812 UTC.

Trends in the coming four-day forecast period will rely on a balance between the departures of sunspot regions over the western limb, and new regions emerging over the eastern limb. Some activity has already been observed from the northeast limb with AR3976 likely responsible for the M2.6 flare from the 27th Jan, and these regions are likely to reveal more complexity than currently stated over the coming days as they rotate further onto the visible disc.

Overall, the daily flare risk increases slightly as AR3976 rotates westward . Low to Moderate solar activity is expected with a chance of further isolated M-class flares and a slight chance of X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	30	30	40	40
Very Active	R3-R5 (X Class)	No	1	1	5	5

Figure 3: GOES 16 and 18 X-Ray flux



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Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and is most likely to stay that way. However, there is a slight chance of it rising above the S1/Minor Radiation Storm threshold in the coming days, mainly due to AR3961 which is now over the western limb. This region will have rotated well away from the west limb by Day 2 (29 Jan) so this risk declines through the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been mostly at moderate levels over the last couple of days, briefly reaching high levels on 27 Jan before dropping back down to background. In the absence of further geomagnetic activity from CMEs or HSS, a continued decline in flux levels is forecast.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving reasonable guidance here, although clearly the forecast fluence is lower than currently observed.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES16 ElectronFlux three day plot

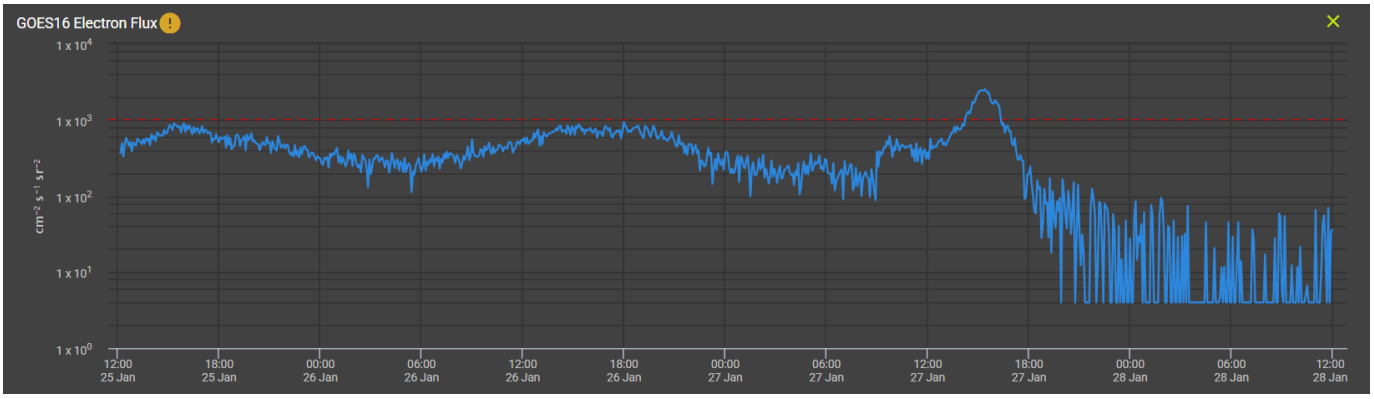

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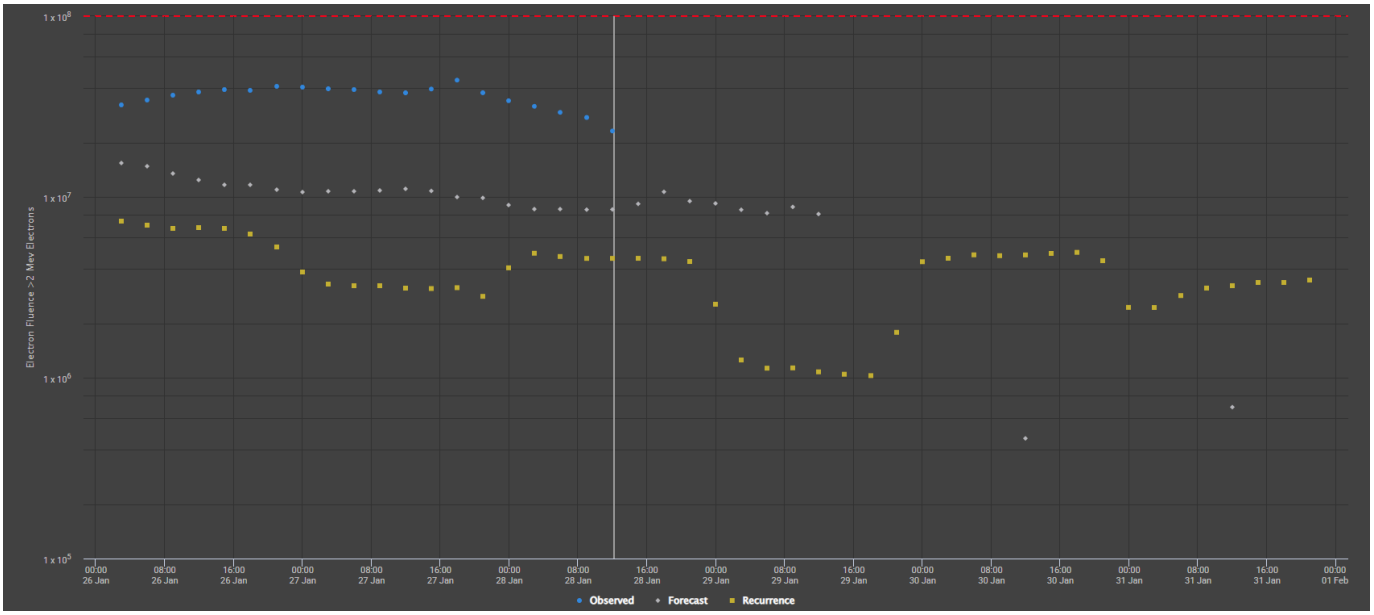
Figure 5: MOSWOC REF Model



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